Weather Clim. Dynam. Discuss., referee comment RC1
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Comment on wcd-2021-72

Anonymous Referee #1

Referee comment on "Regime transitions of Australian climate and climate extremes" by Jorgen Segerlund Frederiksen and Stacey Lee Osbrough, Weather Clim. Dynam. Discuss., https://doi.org/10.5194/wcd-2021-72-RC1, 2021

Review of "Regime transitions of Australian climate and climate extremes" by Frederiksen and Osbrough

This study attempts to explain changes in regional temperature, rainfall and streamflow in Australia by analysing the observational record and reanalysis. The authors suggest regime transitions are identifiable in the extreme timeseries.

I have a couple of major concerns with this study. The second major concern I think warrants rejection of this study in my opinion unfortunately.

Major concerns:

1. The actual purpose of the study is unclear to me. The paper, while written in a way that's grammatically correct, doesn't really flow and is missing important sections, such as a Methods section. The motivation and novelty of this work needs to come through much more clearly. In addition, the lack of a Methods section would make the paper very difficult to reproduce.

2. 'm afraid to say I think that the extremes-based results are largely artefacts of the use of decile-based indices that are defined over long seasons. Given these deciles are defined based on some climatological period (which I don't see defined anywhere) and you're looking at area coverage of top decile values, a small shift in the distribution of seasonal-average temperatures will result in a big increase in the incidence of top decile events. The relatively low interannual variability in seasonal temperatures (compared with daily

extreme indices) and the spatial homogeneity of the temperatures mean that large jumps in the extreme index would be entirely expected.

A test to show that this isn't an artefact of the use of area of top decile seasonal-average temperatures would be to use an inherently noisier index, such as a daily extreme index like aggregated area exceeding a high percentile.

Other comments:

L16-17: I'd suggest not talking about first and second order transitions in the Abstract as at this stage in reading the paper it's not clearly what this means.

L86: "Pert" should be "Perth"

Section 2.2. This is a bit brief- perhaps a summary of what variables were used and why NCEP and these variables were chosen would be helpful. NCEP1 exhibits quite different trends in extremes to other reanalyses in this region (Donat et al., 2014) so some comparison with another dataset would be helpful.

L95-97: Another relevant paper is Delworth & Zeng, (2014).

L124-125: The focus on a quadratic fit suggests there is a physical reason why this relationship would be quadratic, but I suspect there isn't. It might be more useful just to focus on the rainfall-streamflow relationship without this fit applied.

L140: The definitions used here for Southern Wet Season and Southern Cool Season are so similar that I think it's redundant to say the results are similar for these two.

L208-209: I think you mean the timeseries are synchronous rather than the variability is the same.

L234: "average" should be "on average"

Section 5 without any further analysis is unnecessary as it doesn't add to the paper.

L251: Comma needed after “variability”

References

Delworth, T. L., & Zeng, F. (2014). Regional rainfall decline in Australia attributed to anthropogenic greenhouse gases and ozone levels. *Nature Geoscience*, *7*(8), 583–587. https://doi.org/10.1038/ngeo2201

Donat, M. G., Sillmann, J., Wild, S., Alexander, L. V., Lippmann, T., & Zwiers, F. W. (2014). Consistency of Temperature and Precipitation Extremes across Various Global Gridded In Situ and Reanalysis Datasets*. *Journal of Climate*, *27*(13), 5019–5035. https://doi.org/10.1175/JCLI-D-13-00405.1